

# Lake of the Woods Sustainability Assessment

## Capstone Paper

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## List of Acronyms

LOW: Lake of the Woods

MN DNR: Minnesota Department of Natural Resources

SES: Socio-ecological system

SWOT: Strengths, Weakness, Opportunities, and Threats

TMDL: Total Maximum Daily Load

WRAPS: Watershed Restoration and Protection Strategy Report

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## Executive Summary

This report is intended to provide the Lake of the Woods Keep it Clean Committee with an improved understanding of the environmental management challenges related to increased ice fishing pressure on Lake of the Woods, particularly in relation to the use of independent wheelhouses on the lake. Uncertainty about the extent and nature of the impacts from ice fishing and wheelhouse use is currently impeding the effective management of lake usage and the delivery of public services.

Based on a synthesis of qualitative research, case studies, and literature on environmental management, this report provides the following policy and process recommendations that the Keep it Clean Committee can utilize to help address pollution concerns, protect their fisheries, reinforce strong local governance systems, support a robust ice fishing economy, and serve both residents and visitors to LOW now and in the future:

- Develop and implement a lake access surcharge to secure additional project funding
- Focus educational efforts on the lake access point-of-contact with wheelhouse users
- Expand the role of resorts in the work of the Keep It Clean Committee
- Continue community engagement through surveys, town halls, or other methods

We have also identified two specific project directions that could form the basis for continued collaboration between the Keep It Clean Committee and the Humphrey School of Public Affairs. These projects are:

- Educational program design for angler orientation on sustainable ice fishing
- Case study research on local governance approaches to environmental management



## Introduction

The ways in which ice fishing takes place on Lake of the Woods, and across much of the United States, has changed drastically in recent years. Where people once parked a simple ice fishing house, people are now parking elaborate, fully equipped fishing trailers (wheelhouses) pulled behind a vehicle. These trailers include many of the comforts of home, including appliances, televisions, lighting, heat, bathrooms and beds. This allows anglers to remain on the lake for longer periods of time, and potentially spend less money in the local economy because their trailers are fully stocked. There are potential direct and indirect socio-economic impacts resulting from this proliferation of modern ice fishing trailers, although there is limited knowledge regarding the depth and severity of these impacts.

There also appear to be environmental impacts associated with the use of modern wheelhouses and the increase in ice fishing more generally. Recently, there have been occurrences of littering and refuse dumping on the ice. A potential cause of this problem is the lack of proper waste disposal infrastructure on or near the lake. To address this, Lake of the Woods Keep it Clean Committee placed several dumpsters at popular access points and resorts. In five years of campaigning for ice anglers to pick up after themselves, the committee collected an estimated 500 tons of waste in seven strategically placed dumpsters. However, this program was discontinued in 2018-2019 fishing season due to the unsustainable cost of maintaining the dumpsters, theft of service, and other misuse.

Furthermore, Lake of the Woods is beginning to see the effects of a changing ice season throughout northern Minnesota. As the ice seasons of Lake Mille Lacs and Red Lake further south become shorter and less predictable, Lake of the Woods is seeing heavier winter traffic, especially in the very early and very late weeks of ice season. This increase in overall traffic combines with the relative independence of wheelhouse users to put an increasing amount of pressure on the lake as a resource. Though Lake of the Woods is large, the effects of increased pressure are visible, bringing into question whether the current governance on the lake during winter is adequate to protect this shared resource that is valued highly by the surrounding communities.

The purpose of this study is to better understand the recent changes in ice fishing on Lake of the Woods in relation to the increased usage of wheelhouses and increased overall fishing pressure on the lake. The report is intended to serve as both a reference of the available

information surrounding the socio-ecological system in the Lake of the Woods region and as a set of recommendations to the Keep it Clean Committee and the Lake of the Woods community as they work to address the impacts of increased ice fishing in the region. To meet the needs of the Keep It Clean Committee, the report is guided by the following research questions:

- 1) What is the relationship of ice fishing to the local communities and the economy of the region?
- 2) How can ice fishing and sleeper houses be managed effectively to respond to both current impacts and potential future pressures?
- 3) What is the role of informal governance in the management of the local ice-fishing industry?

The complexity of the Lake of the Woods case demands an interdisciplinary and community-based approach, with the goal of providing a deep understanding of the case and generating meaningful policy recommendations. Beginning with the literature review, the report will acknowledge previous work done in the fields of socio-ecological systems, ecosystems management, and governance, providing a theoretical framework for the case. The case background summarizes and consolidates existing knowledge about ice fishing on LOW, looking at it as a series of related, but distinct practical problems. Informed by a systems approach, we then examine LOW as part of a system of major walleye fisheries in Minnesota. Mille Lacs Lake and Red Lake, two other prominent walleye fisheries in Minnesota, provide the basis for the case studies, both having faced serious environmental management challenges in the last 20 years. The implement environmental management strategies in these two cases are provided as cases from which the LOW community can learn in order to meet present and future management challenges. The community-based qualitative research in this report follows an iterative model intended to explore community perceptions about ice fishing and wheelhouses while also exploring support for potential policy solutions and generating new ideas. A holistic portrait of the Lake of the Woods case is provided in the form of a SWOT analysis that blends the findings from the qualitative research and the case studies. Finally, policy and process recommendations are provided to the Keep It Clean Committee on the basis of the SWOT analysis, along with potential avenues for future collaboration with the University of Minnesota.

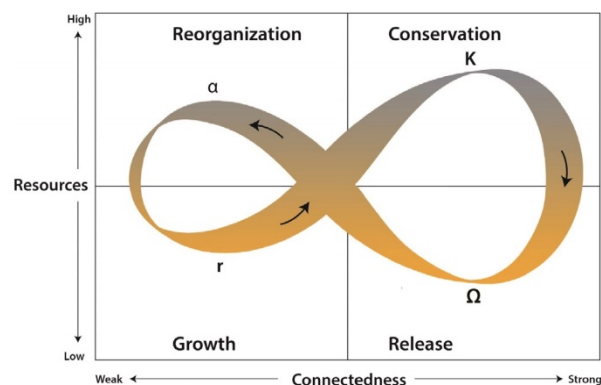
## Literature Review

### Socio-Ecological Systems

The relationship between ice fishing and the Lake of the Woods (LOW) region is a complex, local issue that reflects many of the challenges faced by communities around the world in the management of natural resources. The growing body of academic literature concerning socio-ecological systems, defined simply as “integrated systems in which people interact with natural components”, explores the complexity of these systems through the integration of the ecological and social sciences (Liu et al, 2007). Markets and governance as well as changes in land use and climate patterns are just some of the factors influencing these systems.

The complexity of socio-ecological systems has led to the generation of a variety of models that aid in conceptualizing the functioning of these systems. **Figure 1** shows the adaptive cycle model, which has been used to describe the cyclical functioning of social, ecological, and socio-ecological systems. The space from growth (r) to conservation (K) is the space where environmental management primarily takes place. When conservation efforts no longer sustain the status quo, the system goes through periods of collapse and reorganization before new growth occurs. In order to effectively manage a complex SES, environmental management and governance must be approached in a way that works with the system to both promote conservation when possible and adapt to significant changes when necessary (Auad et al, 2018).

Figure 1: Socio-ecological systems model (Auad et al, 2018)



## Modern Ecosystem Management

The modern approach to ecosystem management is often based on a maximum sustainable yield approach and is used in the Lake of the Woods region in, for example, the MN DNR Fisheries Management Plan. This type of

ecosystem management is carried out through institutions that usually exhibit formal, hierarchical structures and rely heavily on scientific data, aligning with the polar positions on the left in **Figure 2**. However, a variety of research suggests that this approach can lead to more vulnerable ecosystems and formal management institutions that are unable to manage the complexities of the socio-ecological system in which they operate in order to sustainably govern a natural resource. The core challenge here can be understood in terms of the fit between conservation instruments, the dimensions of governance, and the socio-ecological system in which they are applied.

An alternative to the narrow ecosystem management approach described above is found in the ideas of collective action and polycentric governance pioneered by Elinor Ostrom (Ostrom, 1990). This approach is characterized by collaboration between a variety of institutions, operating at the local level as well as higher levels of government. More reflective of the polar positions on the right in **Figure 2** above and often characterized by informal local governance, the polycentric governance approach is carried out through a distributed network of stakeholders. Participatory processes are identified as essential in polycentric governance in order to increase the fit between conservation mechanisms and the socio-ecological system through the incorporation of diverse local perspectives and knowledge (Sarkki et al, 2015).

## Governance of Ice Fishing Communities

Research conducted in the fishing villages on Mille Lacs Lake contains insights into the development and governance of these communities that may be generalizable, at least in part, to the Lake of the Woods. Due to the absence of formal institutions and property rights on the ice, informal networks and governance developed with resorts as primary actors. The resort owners in this case serve many roles, from the establishment of informal environmental regulations on

*Figure 2: Dimensions of Governance (Van Assche et al, 2014).*

Choice Dimension	Polar Positions
Institutions:	Formal ↔ Informal
Steering:	Central ↔ Network
Democracy:	Representative ↔ Participatory
Knowledge Type:	Scientific ↔ Local

the ice to conflict mediation (Van Assche et al, 2014). In the context of ecosystem management, this study suggests that resort owners are a key part of the governance of ice fishing communities and therefore essential participants in a polycentric approach to conservation. Better understanding of the role of resort owners and existing governance practices on the Lake of the Woods will be necessary to understand the extent to which these findings translate beyond the boundaries of Mille Lacs Lake.

## Case Description

Lake of the Woods, spanning the border between northern Minnesota and Canada, is a world class fishery, and tourism related to fishing, boating, and other outdoor related pursuits is extremely important to the local economy in Lake of the Woods County. In recent decades, ice fishing has dramatically increased in popularity, which is primarily attributed to the length of safe ice conditions and the inclusion of modern amenities. The effects of this increase may have implications for the region's economic, social, and ecological systems.

In many ways, ice fishing on the Lake of the Woods begins and ends with the private resorts located on the shore. Before the fishing season begins, resort operators monitor the ice levels and start setting up fish houses as soon as it is safe. Once the season is in full swing, resorts provide everything from plowed roads on the ice to fish cleaning at the end of the day as well as providing guide services and maintaining supplies in their rental fish houses (Dokken, 2017). These ice roads make it possible for fully-equipped wheelhouses, oftentimes towed all the way from the Twin Cities, to enter and explore large swaths of the lake. This infrastructure, combined with the quality of the water and fisheries in the Lake of the Woods make it an ideal destination for users of sleeper houses that set up in one spot and fish for days at a time (Dokken, 2019).

Recent changes in ice fishing on Lake of the Woods (LOW), particularly the use of modern sleeper houses, may be having increased ecological, economic, or social impacts on the lake and surrounding communities. Uncertainty about the extent and nature of these impacts is impeding the effective management of lake usage and delivery of public services.

## Ice Fishing Technology

In the Star Tribune, C.B. Bylander succinctly summarizes the advancements in ice fishing technology, many of which he says are being driven by the production and popularity of

pull-behind wheelhouses (of which sleeper houses are a subset). For example, Ice Castle Corp. in Montevideo, MN, began making wheelhouses in 1997 and has been selling about 3,000 per year in recent years. Brett Drexler of Ice Castle Corp. notes that the wheelhouses make ice fishing more family oriented as well, with the inclusion of stoves, toilets, showers, furnaces, and sleeping space.

Battery operated ice augers make it easy to drill through ice from inside a wheelhouse without the downsides of gas-powered augers. Ice fishers are also using underwater cameras in conjunction with flat-screen tv's in wheelhouses to enhance the fishing experience and sonar to locate better fishing spots. Still another advance is all-seeing sonar technology that scans the water column in all directions. It does so while transmitting images to a video screen in real time. This means an angler can drill a hole, drop a transducer into it, and quickly take a panoramic look at the fish nearby. These advances in technology have made ice fishing more accessible and attractive than ever before; in 2016 alone it is estimated that anglers spent a collective 2 million hours on the lake and kept nearly 350,000 pounds of walleyes and 325,000 pounds of saugers (Dokken, 2017). Combined with the increasing length of fishing trips thanks to wheel houses, concern about the pressures on fish populations remains even with existing fishing license procedures and catch limits (Bylander, 2019).

## **Litter on the Ice**

Empty beer cans, discarded food, cardboard boxes, fish guts, old tires, bags of human feces, and empty propane cylinders are common items that have been left on the lake in recent years. The dramatic increases in wheelhouse traffic on the lake is at least in part to blame for the increase in garbage left on the lake as well. To deal with this litter, the Keep it Clean Committee was formed in 2012, and in its first five years, collected 500 tons of trash in seven dumpsters located at resorts and public accesses (Kennedy, 2017). Keep it Clean Committee members stated that less trash was found along shorelines during the years that the dumpster program was in effect (Kennedy, 2017). Unfortunately, the cost of the program became unsustainable due to the popularity of the program and misuse of the dumpsters and the program was discontinued for the 2018-2019 season.

## **Watershed Management**

As part of the State of Minnesota's water quality management plan, the LOW Watershed has been the subject of a variety of studies since the beginning of the 10-year management cycle starting in 2012. The goals of this management project are to "assess the state of waters in the watershed, identify areas of concern for water quality, and develop restoration and protection strategies for use in future management" (HEI, 2012). The project is focused on the Minnesota portion of the watershed, about 730,000 acres in north-central Minnesota. The Lake of the Woods makes up about 41% of this area, while another 30% consists of other lakes and wetlands and 20% is in agricultural use along the southern shore of LOW (MPCA, 2016).

## **Fishery Management**

The Minnesota DNR is responsible for producing the LOW Fisheries Management Plan on a 5-year basis, with the most recent report encompassing the years 2018-2023. After a period of concern around over-exploitation of the walleye population in the mid 1900's, commercial fishing in the LOW was ended in 1985. Recreational (sport) fishing on the LOW has historically concentrated on walleye and sauger, with a more recent increase in fishing for lake sturgeon. While the report identifies the walleye and sauger populations as currently doing well, harvests have exceeded potential yield estimates and winter fishing is identified as a contributing factor to the pressures of maintaining these fish populations (MN DNR, 2018).

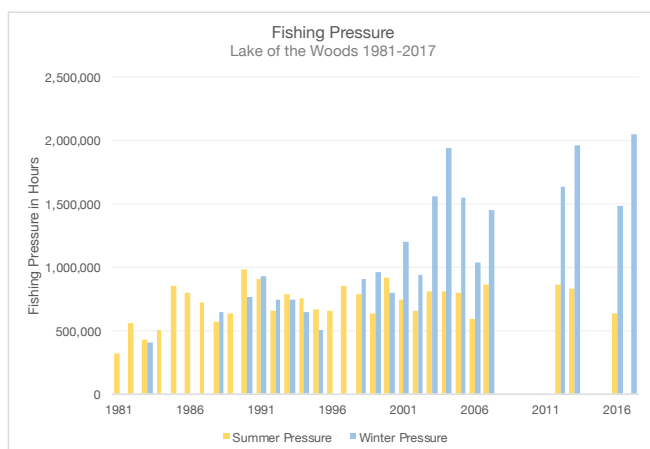
On March 1, 2019, winter walleye and sauger limits on Lake of the Woods were lowered to accommodate for a trend of increased winter fishing pressure. The walleye and sauger limit were reduced from eight to six, with no more than four walleyes. The protected slot limit remained in effect; requiring anglers to immediately release any walleye between 19.5 and 28 inches, with only one fish over 28 inches allowed in possession (Forum News Service, 2019). Increased winter fishing pressure, and a decrease in the number of reproducing male walleye in the lake caused the MN DNR to reconsider catch limits. Although pressures on the fishery have become more acute in recent years, the walleye and sauger fishery is still widely considered to be healthy and self-sustaining.

## DNR Creel Surveys

The Minnesota DNR uses summer and winter creel surveys to monitor the recreational fishery in LOW. These surveys have been tracking summer and winter fishing pressure, walleye harvest, and sauger harvest for most years since 1981.

**Figure 3** shows that winter fishing pressure has increased substantially over time, from 500,000-1,000,000 hours prior to the year 2000 to as much as 2,000,000 hours in recent years. Over the same time period, summer fishing pressure has stayed relatively consistent in the 500,000-1,000,000-hour range.

Figure 3: Fishing Pressure on Lake of the Woods (MN DNR, 2018)



The changes in relative summer and winter fishing pressure correspond with substantial increases in the winter harvests of both walleye and sauger over the same time period as shown in **Figures 4 & 5**. Of particular note, the winter walleye harvest has matched and even exceeded the summer harvest in recent years while the winter sauger harvest outpaced the summer harvest in every recorded year.

Figure 4: Walleye Harvest on Lake of the Woods (MN DNR, 2018)

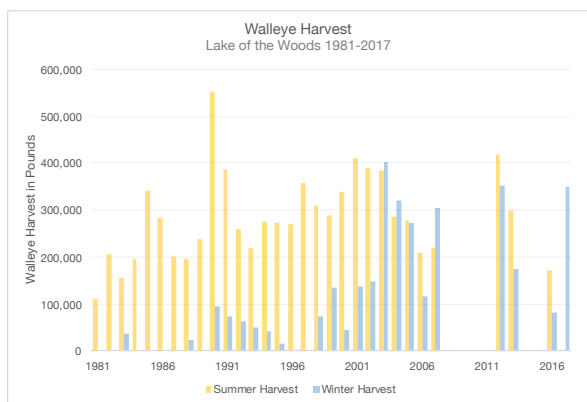
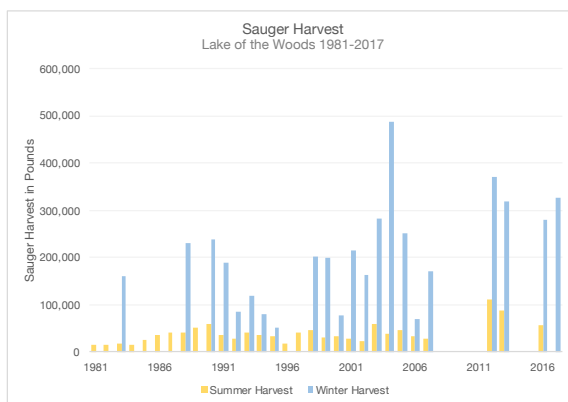


Figure 5: Sauger Harvest on Lake of the Woods (MN DNR, 2018)

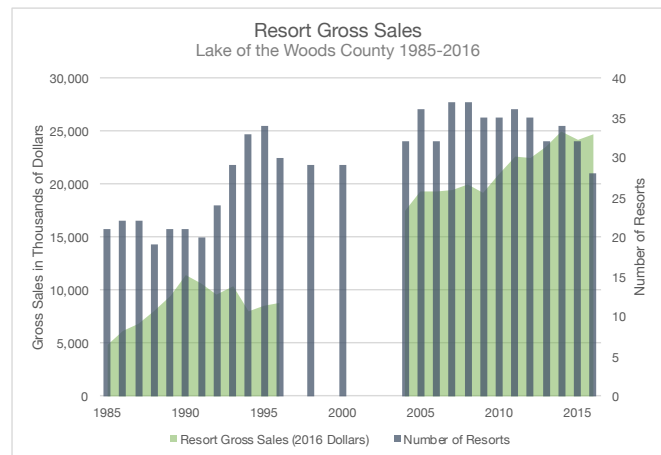




## Resort in Lake of the Woods County

The Minnesota Department of Revenue produces a variety of reports related to the tourism industry in the state. Since the resorts located around Lake of the Woods provide the primary means of winter access through their maintained ice roads, an understanding of how their business has changed over time may help to inform understanding of the LOW SES as a whole. As **Figure 6** shows, the number of resorts increased from about 20 in the early 1980's to a high of more than 35 around 2008 before falling back below 30 in 2016, the last year for which data are available. Since the mid 1990's, gross sales appear to have risen substantially, from about \$8 million in 1994 to nearly \$25 million in 2016.

*Figure 6: Resort Gross Sales in Lake of the Woods County (MN Dep. of Rev.)*



## Case Studies: Red Lake and Lake Mille Lacs

Recognizing that changes in ice fishing in Lake of the Woods may be related to changes in ice fishing in other major lakes in Minnesota, we studied the recent history and environmental management practices surrounding Red Lake and Lake Mille Lacs. Through these case studies we explored the timeline of important events on these lakes in relation to the changes witnessed in Lake of the Woods as well as the environmental management practices employed in these two cases and their impacts on the surrounding socio-ecological systems.

### Overview

In 1999, Red Lake's walleye fishery was closed on both state and tribal waters. This was a result of a walleye population fallout that began in the early 1990's due to overharvest from commercial and sport fishing as well as poaching. The walleye fishery remained closed for the next seven years and underwent intensive fisheries management. In 2006, fisheries experts deemed the walleye population to be at a sustainable population and the fishery was reopened under strict harvest regulations. Around the same time Red Lake closed their fishery, another destination walleye fishery in Minnesota was in trouble.

Prior to the year 2000, Lake Mille Lacs had been well known for the quality of the walleye fishery. Anglers from all over the nation would travel to the lake to fill their bag limit and have the chance at catching a trophy walleye. However, this reputation began to disintegrate around 2000 because the walleye population began to decline. Unlike Red Lake, the walleye population decline in Lake Mille Lacs was not directly cited as a result of overharvest. Many factors were cited in the population decline, but the most prominent one was the impact of changing water conditions including temperature, clarity, prevalence of predator fish species, and aquatic invasive species. Lake Mille Lacs walleye fishery management is an ongoing struggle and continues to have devastating impacts on the region's socio-ecological system. The events that have played out at Red Lake and Lake Mille Lacs are indicative of the increasing winter fishing pressure on Lake of the Woods.

As noted earlier, the winter fishing pressure on Lake of the Woods increased substantially beginning in 2000. The closure of Red Lake's walleye fishery and the declining walleye population in Lake Mille Lacs also occurred around this same time frame. The combination of the occurrences at Red Lake and Lake Mille Lacs as well as the rise in wheelhouse popularity

has most likely influenced the socio-ecological system in Lake of the Woods through an influx of ice angling. These case study examples can be used for future projections of ice angling pressure and the potential impacts that may ensue in Lake of the Woods region. Additionally, these case studies will be further analyzed to provide application for governing the socio-ecological system in Lake of the Woods and provide evidence for the project's analysis and recommendations.

## **Case Study 1: Lake Mille Lacs**

### **Background**

Lake Mille Lacs is a shallow basin lake located an hour north of the Minneapolis-Saint Paul metropolitan area in Mille Lacs, Atkin, and Crow Wing counties. The lake is the second largest in Minnesota and has a long-standing reputation of being a high-class walleye fishery in the Midwest. However, there has been a significant decline in the quantity of walleye in the lake as indicated by annual surveys conducted by the Minnesota Department of Natural Resources (MNDNR). Aside from the biological effects, the decline of walleye and resulting management strategies implemented threaten the socio-economic system of the region. The economy of the Lake Mille Lacs region is dependent on the influx of anglers attracted to the destination fishery. Management strategies implemented by the MNDNR have caused many anglers to travel elsewhere for the fishing trips.

Controversy over management of Lake Mille Lacs has been at the forefront of Minnesota's political field as Minnesota residents are looking to government officials for management solutions. A 2018 GOP hopeful, Jeff Johnson, criticized the co-management between the MNDNR and tribal nations during a speech near Mille Lacs in July of 2018. In 2017, Mark Dayton, former Minnesota governor, cut a Lake Mille Lacs fishing trip short after protestors took to the water to advocate for better fisheries management. The complexity of the variables contributing to the walleye population decline makes managing the socio-ecological system a challenge. Successful implementation of fisheries management is dependent on the co-management between involved stakeholders. An overview of the implemented socio-ecological management strategies for the lake's region will be discussed, followed by the application to Lake of the Woods.

## Implemented Management Strategies

Management of a fishery at this scale and complexity requires contribution from many stakeholders and government agencies. A few of the main stakeholders in the Lake Mille Lacs case is resort owners, other local businesses, the Ojibwe Tribe, Lake Mille Lacs anglers, Minnesota DNR, and the Minnesota Department of Tourism. Inclusive planning for public participation in decision making regarding the lake is challenging and has created some distrust because of the lack of transparency regarding evidence supporting management decisions. This is especially true for stakeholders who are emotionally invested in the Lake Mille Lacs fishery.

Resort owners on Lake Mille Lacs have founded their business on the quality of the walleye fishery and the selection of fisheries management strategies can adverse effects on their way of life. Around 2000, when the walleye decline began, the Minnesota DNR started intensive monitoring of the walleye population to make informed management decisions regarding the fishery. Over the years, walleye regulations on Lake Mille Lacs have been added, modified and removed to accommodate the fluctuation of walleye age structure and population trends. Regulations have included limiting the bag limit, slot size, establishing quotas, banning night time fishing, and even complete closures of the fisheries. Unfortunately, the best management decisions for the fishery have not resulted in ideal conditions for the socio-economic system of the region.

The decline of the walleye population and the management strategies that ensued have created a downward slide in the Lake Mille Lacs region economy due to a lack of tourism. Traditionally, destination anglers made trips to Lake Mille Lacs for the opportunity to fish on a high-quality walleye fishery. Regulations before the walleye decline allowed anglers to harvest much more fish as trophies or sustenance. However, the decrease in walleye bag limits and closure of walleye fishing have forced these anglers to seek other destination walleye fisheries like Red Lake, Lake Winnibigosh, Lake Winnipeg, and Lake of the Woods. The lack of anglers headed to Lake Mille Lacs left resorts and other local businesses fighting to stay afloat.

To combat the decrease in economic production the Minnesota Department of Tourism has developed an economic revival plan, advertising alternative recreation to the area including targeting other fish species, snowmobiling, hunting, and leisure activities like golf, casino gambling, and arts and crafts. Fishing for other species offers a great alternative to the absence of walleye fishing. Northern pike biomass and number of smallmouth bass have seen great

increases since the decline of walleye (Appendix III). Aside from alternative recreation, another component to their marketing strategy is advertising activities for all ages to attract families. Marketing to families draws from a broader population than traditional “guys weekend fishing trip” demographics, common to destination fisheries. The socio-ecological management strategies and the corresponding stakeholder responses in the Lake Mille Lacs region can be analyzed and applied to strengthen socio-ecological system in Lake of the Woods region.

## Case Study 2: Red Lake

### Background

At 48,000 acres, Red Lake is Minnesota’s largest lake entirely within the state boundaries and the 16th largest state in the United States. Another aspect that makes Red Lake unique is the majority of water is under the Chippewa tribe ownership and only a small expanse is state owned. Non-members of the Chippewa tribe are not allowed access to the tribal owned waters which make up 83% of the total area. Regardless, Red Lake has long been known as a destination fishery for the quality and abundance of walleye. However, this was not the case in the late 1990’s through the mid 2000’s. Heavy commercial fishing by the Red Lake Tribe of Chippewa, sport anglers, and unreported poaching led to a crash in the walleye population in the late 1990’s, leading to a closure of the fishery in 1999. Cooperative fishery management between the Minnesota DNR and Red Lake Tribe led to one of the greatest walleye success stories to date. Seven years after the fishery was closed to all fishing, Red Lake supported a sustainable walleye population and was reopened to tribal and sport fishing.

The walleye population decline in Red Lake differs from Lake Mille Lacs because the decline was the result of overharvesting and not changing water conditions. Commercial fishing on Red Lake began during World War I, serving as a source of economic productivity for the region. For many decades, the fishery proved to support a sustainable walleye population until boom and bust cycles of walleye fishing started occurring in the 1970’s. The boom and bust cycles as a result of commercial, sport and illegal harvest removed the last strong walleye class prior to reproduction maturity, leading to a collapse in the mid 1990’s.

Both the state and tribal nation acknowledge the need to establish a cooperative agreement to revive the walleye population and a historical memorandum of agreement was established in 1999. In addition to the closure of the fishery, the state and band conducted three stockings of walleye fry. Early estimates predicted the fishery reopening ten years following the

closure, but the revival of the walleye fishery far exceeded expectations and tribal and state waters was reopened to fishing in 2006. Since then, the walleye population continues to thrive and support a sustainable level thanks to the cooperative efforts between the band and Minnesota DNR.

### Implemented Management Strategies

Walleye fishing provides unmatched benefits to the economic and ecological status of Red Lake. The population crash and closure of walleye fishery placed ecological and economic stress on the region and its residents. A lack of walleye in the lake allowed other species of fish such as crappies to establish a healthy population. The quality of crappie fishing brought in angler tourism, but not nearly to the scale that walleye fishing did. This resulted in fishing resorts, bait shops and other local businesses suffering from the lack of angling tourism. The primary management focus for the region was strategically revitalizing the walleye fishery through stocking efforts and population evaluation. Walleye fry were stocked in three separate years, 1999, 2001 and 2003. Population evaluations found that these efforts proved to be extremely effective in restoring the walleye population.

Following the opening of the fishery, a memorandum of understanding between multiple government agencies and the band set forth a strategic management plan to ensure walleye harvests are sustainable. The three primary components of the plan included annual harvest estimates, population evaluations and population forecasting on state and tribal waters. Effective cooperation between the band and state agencies ensures holistic fisheries management occurs across state and tribal waters. Similar to Lake Mille Lacs, the Red Lake region economy suffered tremendous losses during the closure of the walleye fishery. The losses were felt across the entire region from commercial anglers from the band to small business owners off the reservation.

The loss of angler influx to the region due to the fishery closure left resorts, bait shops, and other local businesses scrambling to keep their doors open. The lone gas station in the once bustling fishing tourist town of Waskish closed their doors shortly after the fishery closed. In response to the rippling effects through the economy, a community task force developed and convened with the headwaters regional development commission to create a strategic regional plan. The regional plan entailed 15 potential projects to stimulate economic growth, but one project stood out from the rest. This project involved the creation of Big Bog Interpretive Center

and Recreation Area which now draws in tourists from all over to partake in the onsite recreational opportunities offered. Some of the major recreational opportunities offered include camping, canoeing and kayaking, bicycling, swimming beach and snowmobiling. This development helped bring tourists to the region but did not prevent other businesses from closing their doors.

## Case Study Analysis and Application to Lake of the Woods

The Lake Mille Lacs and Red Lake case studies offer contains a wealth of knowledge that can be applied to the socio-ecological system in Lake of the Woods. Lake Mille Lacs and Red Lake have both experienced economic hardships because of a collapse in their walleye fishery. Prior to the decline, both fisheries bolstered high quality walleye fishing just like Lake of the Woods. Continued success, year after year, made it hard to imagine a collapse in the walleye population and turn for the worse. A common theme between the two cases was the need for reactive planning and recovery to offset the biological and economic impacts. Lake of the Woods region will benefit from proactive planning as opposed to reactive planning. This report is one component of the proactive planning in Lake of the Woods region. The events that led up to and unfolded after the closure of the walleye fishery in Lake Mille Lacs and Red Lake provide three key takeaways that can be applied to the Lake of the Woods socio-ecological system: (1) the importance of scientific knowledge and management transparency, (2) understanding and including all stakeholders impacted by management strategies, and (3) the importance of economic alternatives in addition to the walleye fishery.

First, the socio-ecological problems experienced in the Lake Mille Lacs and Red Lake regions illustrate the importance for transparent presentation of scientific knowledge and the ensuing management strategies. Residents and business owners alike have shown a distrust towards the Department of Natural Resources scientific evidence and selected management strategies. The core strategies used to survey the walleye population before the collapse are still being used today but have received criticism. This allows continuous comparisons of the walleye population from year to year. However, people are disgruntled about the survey methods, stating that the netting locations are not being conducted in areas of the lake with higher walleye concentrations. The state has even called upon an independent team of experts in the fisheries field to conduct a review of the DNR's management plan to ensure appropriate methods are being conducted.

Unlike Lake Mille Lacs, there is comparatively little strife towards how the DNR and band have implemented management strategies on Red Lake. Most of the parties involved recognized that the walleye population was threatened. While residents and traveling anglers were unlikely to be happy about the decision to close the fishery, most of them understood the need to implement a recovery plan.

These two case studies highlight the importance of transparent scientific data collection and implemented management strategies in Lake of the Woods region. Scientific data and information collected from Lake of the Woods should be thoroughly communicated to stakeholders in the region. This should be conducted in plain language and contain terminology that is understandable for the average individual. Communication is an important facet when attempting to implement new management strategies but should occur throughout the development as well as implementation processes so that stakeholders have a substantive role in the design of management strategies.

Second, the socio-ecological problems experience in the Lake Mille Lacs and Red Lake regions illustrate the need to incorporate a complete stakeholder analysis of those impacted by management strategies. From an outside perspective, it appears that the fisheries management of Lake Mille Lacs did not include participation of stakeholders throughout the process which resulted in higher levels of distrust towards the DNR management plan. On the other hand, Red Lake appears to have encouraged stakeholder involvement through an inclusive participation process. Residents in the Red Lake region were still upset about the conditions of the fishery but acknowledged the issue at hand and allowed the DNR and band to appropriately manage the lake. An important consideration that was made in both cases was a stakeholder analysis to understand who was involved and what their beliefs were regarding the fishery. Socio-ecological management strategies in Lake of the Woods region needs to carefully consider who the stakeholders are and what their beliefs are about the region.

Third, the socio-ecological problems experience in the Lake Mille Lacs and Red Lake regions demonstrate the importance of economic alternatives other than walleye fishing tourism. The Lake Mille Lacs and Red Lake region economy relied almost exclusively on the productivity driven by the influx of walleye anglers. With the collapse and closure of the walleye fishery came the economic downturn of resorts, restaurants, gas stations, and bait shops. Looking to offset the economic decline, the regions looked to other sources of economic



productivity through the marketing of other recreational outdoor activities such as golfing, motorsports, and hunting. Unfortunately, the strategy to market other activities was reactive to the situation rather than proactive. The Lake of the Woods community can learn from the challenges brought by reactive planning and decision making in Mille Lacs and Red Lake regions.

## Research Methods

In order to deeply analyze the issues surrounding Lake of the Woods and form policy recommendations, it is important to understand how the lake is perceived and interacted with by community stakeholders. Knowing how stakeholders play a role in and in turn are affected by changes in the lake can help to both understand the mechanisms behind the issues, and potentially propose ways to utilize these mechanisms in implementing solutions.

To this end, a three-part qualitative research method was devised to reach a broad range of stakeholders and understand their unique relationships to the lake. The first part of this method consisted of informal, in-person interviews with stakeholders, with the goal of determining what the perceived issues are, what groups of stakeholders exist, and how these groups' interests align. The second part of this method consisted of two online surveys, intended to reach large numbers of community members identifying with various stakeholder groups. The goal of this part was to understand on what issues consensus existed, on what issues there were divisions (and along which lines those divisions fell), and to solicit innovative policy ideas from community members themselves. The third part of this method consisted of looking at social media focused on the lake, with the goal of understanding the interests and perceptions of a wider variety of stakeholders, including visitors (and potential visitors) as well as locals.

### Qualitative Research Method 1: Stakeholder Interviews

Informal, in-person interviews were arranged with a selection of stakeholders from several different stakeholder groups in the Baudette, MN area from March 1 to March 3, 2019. The purpose of these interviews was not to gather comprehensive data on the opinions held by stakeholder groups (this would be later attempted by the web-based surveys), but instead to gain a broad understanding of the concerns of stakeholders, their roles in the community and on the lake, and their attitudes toward each other and toward various solutions to problems they considered important. Due to the labor intensity of conducting in-person interviews with stakeholders in a dispersed area combined with tight time constraints, a convenience sampling method was used. The team contacted stakeholders from a previously compiled list of about 30 by phone, and arranged in-person interviews with whoever was available and willing, which ended up providing seven interviews in total.

Stakeholders on the list were of various types, including local government employees and chamber of commerce members, members of the LOW Keep-It-Clean Committee, Resort Owners and managers, one gas station owner, and the owners of several garbage hauling companies. Interviews were conducted with two chamber of commerce members, three resort owners, a conservation officer with the DNR, and a gas station owner. Interviews varied greatly in length, lasting anywhere from 15 minutes to over an hour. The list of questions used to guide these interviews is provided in Appendix I. The topics covered include concerns with increases in wheelhouse use on the lake, increased dumping and littering on the lake, gaps in emergency services on the lake, the economic health of the interviewee's business and the community in general, the nature of governance on the lake, and thoughts on potential policy changes by local governing bodies.

## **Qualitative Research Method 2: Community Web Survey**

Web-based surveys were created to be distributed to stakeholders in order to get a comprehensive overview of the opinions of the community as a whole on the issues raised in the in-person interviews. These surveys were distributed by email to the 33 stakeholders on the list provided by the client, and respondents were encouraged to forward the link to other community members so as to provide as many responses as possible. Two surveys were distributed, the first round on April 9<sup>th</sup> and the second round on April 19<sup>th</sup>.

The first survey's questions were based on the responses gathered in the in-person interviews, and the second and final survey was based on the responses to the first. This three-part design is loosely based on the Delphi Method of achieving consensus, which uses a series of surveys or interviews--usually with experts from different fields or backgrounds but with an interest in the survey subject--one after the other, with each subsequent survey based off the responses to the previous one. The latter surveys are intended to dive more deeply into contentious aspects, resolve variations in responses, and generally obtain a consensus among respondents as to the issues at hand and potentially workable solutions (Public Health Action Support Team). In reference to this method, the second survey was shorter and more directed than the first, and focused largely on the questions with the most variation in response from the first survey, while also addressing issues brought up in responses from the first survey. This method also served the secondary purpose of managing survey fatigue. The relative brevity of

the second survey was intended to keep responses at the same level as in the first survey. The questions used in both surveys are provided in Appendix II.

The community web surveys (titled: Lake of the Woods Community Stakeholder Survey) were limited by their number and type of respondents. The surveys were distributed by email to a number of government employees, elected officials, business owners, and other stakeholders with some degree of connection to the Keep-It-Clean Committee; these recipients were encouraged to forward the surveys to anyone else they thought would be interested in responding. This method of selection was not random, and the sample of respondents is not representative of the community as a whole, nor was it intended to be. The basis of these surveys in the Delphi Method of consensus building means that their intention was not gauge the opinion of a broad base of stakeholders, but instead to survey a selection of deeply engaged stakeholders with varying perspectives who might be considered experts in some part of the subject matter. To this end, the majority of respondents hold a stake in the health of the lake

either as resort owners/employees, other business owners/employees, government employees, or elected officials as summarized in Table 1. In Round One of the survey, only six respondents identified only as local residents, two only as frequent visitors, and two as other stakeholders; out of a total of 77 respondents, only 12 were not members of these three major stakeholder groups. In Round Two of the survey, only 8 out of a total of 45 respondents did not identify as one of the primary stakeholder groups.

*Table 1: Survey participation by stakeholder identification*

Stakeholder Group	Round One	Round Two
City/County/State Employee or Elected Official	20	12
Resort Owner/Manager	19	11
Resort Employee	11	8
Other Business Owner/Manager	16	8
Other Business Employee	5	3
Resident Only	6	4
Frequent Visitor	2	1
Other	2	3

Most of the questions asked in Round 2 were based on written responses to the questions asked in Round 1. The purpose of the Round 2 questions was to either dive deeper into a topic

explored in Round 1, or to explore a new topic, brought up either directly in a Round 1 response, or in response to patterns observed in Round 1.

One the notable example of the “deeper dive” questions included “Would you support a policy that limits the number of wheelhouses on Lake of the Woods,” which was developed in response to a surprising level of negative feeling toward wheelhouses in the first survey. Another example of this was a repeat of the question from Round 1: “Of the following options, which would be a reasonable access surcharge [for wheelhouses]?” This question was asked in response to the high number of “Over \$1.00” responses on the first round, and higher dollar amounts were provided as options in the second round.

Of the questions which explore new concepts, one notable example was “If it were determined to be feasible to impose a nightly fee for wheelhouses on the lake, similar to fees imposed for using campsites in some state parks, would you support this policy?” This question was asked due to a response which brought this concept up explicitly. A second example was “If it were determined to be feasible to impose a nightly fee for wheelhouses on the lake, similar to fees imposed for using campsites in some state parks, would you support this policy?” This question was asked due to several responses in Round 1 indicating this might be the case.

## **Social Media Analysis**

Facebook, and other web-based platforms, offer new opportunities for rapid dissemination of information and dialogue with the public that may lead to greater transparency and increased local understanding. Facebook can be a useful tool to share information between people who are not spatially close to each other, such as LOW residents, resort owners, and out-of-town visitors. Members of LOW focused Facebook groups can share local conditions, intel, reports, as well as any problems they have witnessed on the Lake or within the broader community. To gain a better understanding of the dynamics of the ice fishing community in Lake of the Woods, various Facebook groups, as well as local news publications were reviewed and documented. There are several social media pages dedicated to ice fishing in Lake of the Woods, as well as pages dedicated to discussing modern wheel houses also known as “Ice Castles”. Three separate Facebook groups related to LOW fishing, tourism, and wheelhouses were reviewed for this report, including Lake of the Woods Reel Fishing Reports (<https://www.facebook.com/groups/2012705872347592/>), Lake of the Woods Fishing (<https://www.facebook.com/groups/154535645285898/>), and Lake of the Woods Tourism

Bureau (<https://www.facebook.com/lakeofthewoodsmn/>). These Facebook groups were selected because of their high membership rates, frequent posting activity, and high post engagement. A number of other Facebook groups related to LOW and fishing exist, although they were excluded from this research due to the fact that they feature lower membership rates, had fewer ice fishing related posts, or did not post frequently. Posts and comments on the above-mentioned pages were reviewed for the years of 2017 to 2019.

In addition to reviewing social media pages, local newspaper articles were also reviewed. These newspaper articles were from several different publications, including the Northern Light Region, the Warroad Pioneer, the Minneapolis/St. Paul Star Tribune, the Duluth News Tribune, the Mitchell Daily Republic, and Minnesota Public Radio. Local newspaper and social media can provide an intimate look into the opinions and attitudes of both local and non-local stakeholders regarding the changing dynamics of ice fishing and the problems that may or may not be associated with it. Review of these pages revealed that these Facebook pages are used primarily for anglers to field requests for information or services; post fishing, ice, and weather condition reports; share local events and news; and express problems or complaints. Although the posts, comments, shares, and articles within these groups reflect personal opinions, they can offer an important glimpse into the day-to-day realities of fishing and living adjacent to Lake of the Woods.

## Results

### Stakeholder Interviews

The informal interview process contributed broad information about the concerns of stakeholders which directly led to the stakeholder analysis provided at the end of this report, and contributed to the line of questioning used in the web survey. Littering by ice anglers was identified as a major concern by the majority of interviewees, though different solutions were preferred by different stakeholders. These solutions included dumpsters being provided by resorts, or alternatively reinstating the dumpsters provided by the Keep-It-Clean committee, tacking a surcharge onto lake access fees for anglers to help pay for locally provided trash services, and continuing the informal practice of having anglers take their trash home with them, while increasing the presence of anti-littering literature to raise awareness of the problem.

Emergency services on the lake were identified as a concern by some of the interviewees. This was a major topic of conversation on the weekend of the interviews due to a windstorm the week previous that left a few ice anglers stranded in snowdrifts on the lake for several days, requiring intervention by local emergency responders. Some of the interviewees expressed concerns that increases in ice anglers, especially anglers bringing their own wheelhouses rather than using resort-provided shelters, might require increases in emergency services, without the subsequent increases in tourism revenue to help pay for these services. While some interviewees believed these services should be provided by local and state government entities, and that ways should be found to charge anglers for service increases, others believed that most of these services can and should be provided by resorts, as many have in the past.

The third easily identifiable topic from these interviews concerned the economic impacts of the increase in wheelhouse use on businesses. Interviewees expressed widely varying sentiments toward this change, with some, such as the gas station owner and several resort owners, stating that this increase is generally good for business and does not cause problems (as long as rules are followed regarding how many can be let on the ice by each resort), while others, including one resort owner, expressing that this change is bad for business as well as for the health of the lake, and that resorts especially will likely be forced to change their business practices to respond to wheelhouse use.

During the course of these conversations, governance on the lake was covered broadly, and interviewees provided insight into the informal agreements among resorts, most notably in how ice roads are plowed and who is allowed to use these roads. Many of the previously-mentioned concerns such as littering and emergency services were framed in the context of informal agreements and low-profile disagreements (or turf wars) between resorts. There was a strong sense from the interviews that responsibilities toward the lake, considered a common good by most, are continually negotiated among resorts and rely heavily on the turf, the individual anglers, and the volume of anglers that each resort considers itself (and each other) responsible for.

While not explicitly stated in any interviews, it can be inferred that this informal and ever-changing balance of responsibilities among resorts is likely to leave some issues unaddressed. This could occur in a scenario where a resort believes it should not be responsible for a certain responsibility--say, trash clean up on a section of the lake accessed by its own

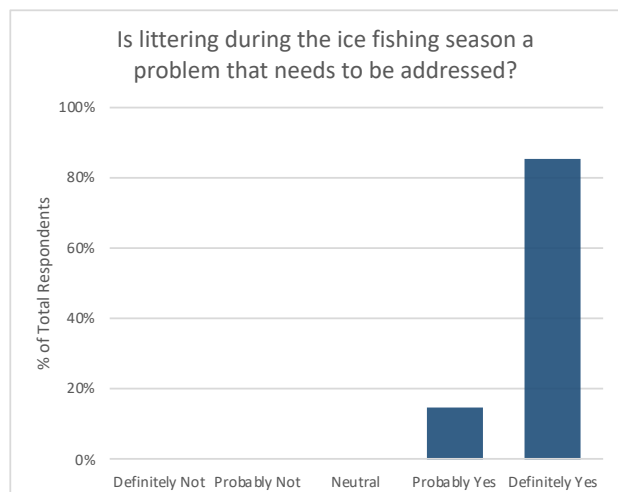
plowed roads, but largely used by a second, smaller resort--and asserts its deferral of responsibility through inaction. If no other resort picks up the slack (which resorts have an incentive not to do, as there is no external enforcement that will prevent this one-time action becoming a yearly expectation), then the consequences will be felt by the entire community. The alternative of the public or a government body picking up the slack could solve the issue, but a mindset of “moral hazard,” which raises concerns that picking up slack caused by failed negotiations among resorts will further reduce their incentive to take responsibility in the future.

Ultimately, the concerns raised by non-resort business owners and other stakeholders largely revolved around the need to protect a shared resource and mitigate the negative effects of increased and changing tourism, while finding ways to capture as much of the economic potential of increased tourism as possible. Concerns raised by resort owners were generally more varied, and provide a window into the complex network of negotiations among resorts that usually keep the needs of anglers and the community met, but often fail in minor, low-profile scenarios. These failures then gradually accumulate and become larger problems felt by the community, such as in the case of increased littering by ice anglers, and to a lesser extent in the case of a weather event requiring local emergency services to intervene to ensure the safety of several stranded anglers.

## Community Web Survey Round 1

Round One of the web survey received responses from all targeted stakeholder groups, including government employees, elected officials, resort owners/employees, and other business owners/employees, as well as residents of the area and frequent visitors. The responses demonstrate a lot of common ground across stakeholders, with all respondents agreeing that Lake of the Woods is important to the communities in which they live and work. Most respondents agreed that ice fishing on Lake of the Woods was important to their work and lifestyle. Respondents also overwhelmingly agreed that littering during the ice fishing season is a problem that needs to be addressed, with 85% saying littering definitely

*Figure 7: Common ground on littering problem.*





needed to be addressed and the remaining 15% saying that it probably needed to be addressed. When asked about who has a role in addressing the problem of littering on Lake of the Woods, most respondents agreed that resorts and the local government/Keep-It-Clean Committee should play a role.

### Dumpsters

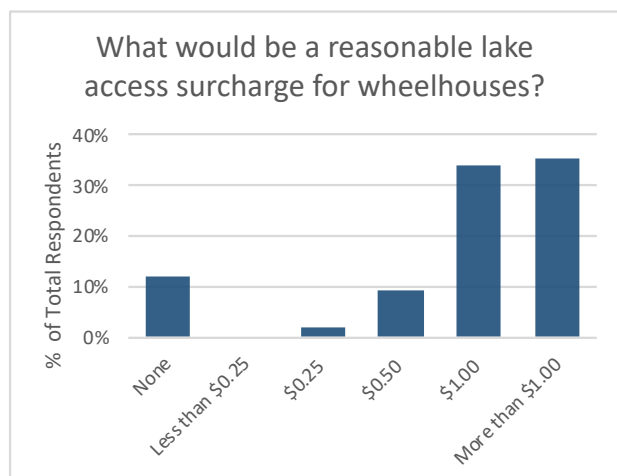
The majority of all respondents to Round One were in favor of reinstating the dumpster program. Out of all of the stakeholder groups, resort employees (but not owners), other business employees, elected officials, city/county/state government employees, and other business owners/managers were most strongly in favor of reinstating the dumpster program. Sixty-seven percent of respondents overall are “maybe” in favor of reinstating the dumpster program. Just under half of resort owners (44%) are in favor of reinstating the dumpster program, while 33% of resort owners are not in favor of reinstating the dumpster program and 22% responded that they are maybe in favor of reinstating the program.

In the short answer response section to this topic, some respondents felt that enforcement should be prioritized around dumpsters to prevent abuse and theft of service, and others felt that the dumpsters should be reinstated, but paid for somewhat or entirely by the resorts whose lake accesses they serve. Notable responses included “The resort/ice fishing business should then pay a set rate to have a dumpster because they are providing a service,” and “Should be provided by the county and subsidized by state angling license or fish house license.”

### Policy Exploration: Lake Access Surcharge

A surcharge on lake access fees that could be used to pay for waste reduction/collection projects and infrastructure was viewed favorably by survey respondents, with 64% voicing support for the policy and another 26% saying that they would maybe support such a policy. Just over 34% of respondents identified \$1.00 as a reasonable surcharge while another 35% of respondents thought that a higher amount than \$1.00 would be reasonable.

Figure 8: Reasonable lake access surcharge (round one).



Elected officials, city/county/state government employees, resort owners, and resort employees were most in favor of adding a surcharge out of all stakeholder groups. Elected officials, city/county/state government officials, frequent visitors, and ‘other’ respondents were most in favor of a \$1.00 surcharge, while resort owners and employees are most in favor of a surcharge over \$1.00. On the other end of the spectrum, 28% of resort owners or managers, 22% of resort employees, 19% of other business owners/managers, and 20% of other business employees responded that they were in favor of no surcharge fees.

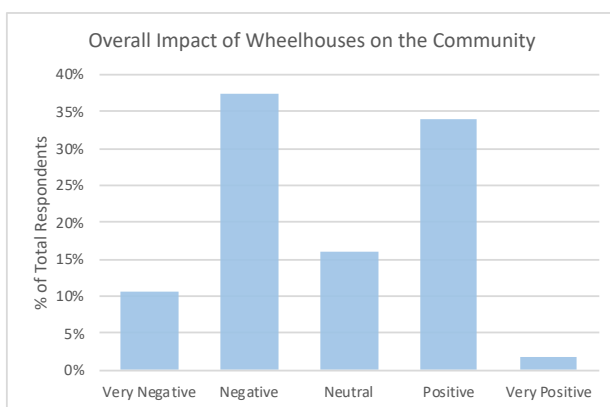
## Wheelhouses

Respondents overwhelmingly agreed that wheelhouses have had at least some impact on the economy in the region, and two-thirds of business owners have made changes to their businesses because of the increased use of wheelhouses. About two thirds of respondents had a positive view of the overall impact of wheelhouses on the communities in the region while nearly half of respondents

held a negative view. Most respondents did not think there was sufficient infrastructure to serve the human waste disposal needs of anglers using wheelhouses. Seventy percent of respondents identified county or state government as the entity that should be providing this infrastructure while nearly 50% placed responsibility on resorts, nearly 40% on local government, and 25% on other businesses (respondents were allowed to select multiple entities.)

According to the survey results, residents responded with the most certainty (100%) that wheelhouses have had a positive impact on the communities surrounding the lake, while resort owners responded with the most certainty (56.25%) that wheelhouses have had a negative impact on the surrounding communities. Elected officials, city/county/state government officials, resort employees, and other business owners/managers and employees were split down the middle on their opinion of whether wheelhouses have had a positive or negative impact on surrounding communities. The majority of resort owners/managers (52.94%) of resort owners/managers responded that wheelhouses have had a major impact on the economy as a whole in the Lake of

Figure 9: Overall impact of wheelhouses (round one).



the Woods. Resort employees were divided equally among ‘little impact’, ‘some impact’ and ‘major impact’ on the economy.

In the short answer response section to this topic, many respondents felt that wheelhouse users were not contributing to the local economy as much as anglers had in the past, while others believed that the overall increase in use of the lake was a positive change overall for the communities. Notable responses included “Short term they have affected some area businesses positively...I am more concerned about the effects on the resource!!” and

Any business providing services associated with wheelhouses have been seen some positive effects. The landfill is filling up quicker than expected due to the excess garbage generated, which is a negative effect. Public safety and emergency response was and has been an issue at times and can be considered negative due to the cost associated with each emergency.

### Emergency Services

In terms of the availability of emergency services such as fire, police, and EMT’s, elected officials (60%), city/county/state government employees (35.71%), resort owner/managers (43.75%), resort employees (75%), other business owners/managers (53.33%), and other business employees (75%) marked that they believe that current services are sufficient. Significant minorities of residents (40%), city/county/state government employees (28.57%), resort owners/managers (37.5%) marked that they did not believe that current emergency services are sufficient during the ice fishing season. All stakeholder groups had respondents who marked ‘unsure’. Improved emergency response time and cell service availability were identified as needs for improving overall safety on the lake.

In the short answer response section to this topic, notable responses included, “Police and emergency medical response teams both need to be in place and have the proper means to get out on the lake. Often times, as a resort, people in distress are calling our business to help them,” and “We usually end up using our bombardiers to transport whoever it may be to the access since the emergency services don't go on the ice. Whether our customers or someone else's.”

### Infrastructure

Elected officials, city/county/state government employees, resort owners/managers and employees, and other business owners/managers responded that they agree with the statement: "In the past decade, the number of winter visitors who use local infrastructure but do not

contribute to the local economy has increased." However, the majority of other business owners responded that they only ‘somewhat’ agreed with this statement.

Nearly all stakeholder groups responded that they do not believe that the current infrastructure in Lake of the Woods is sufficient to support the proper disposal of human waste. Although the majority of resort employees responded that this infrastructure is not currently sufficient, 33% responded that they did believe it was sufficient. City/county/state government employees, resort owners/managers and employees, other business owners/managers and employees indicated that county or state government should be responsible for the infrastructure related to the disposal of human waste, while residents and elected officials were equally in favor of resorts handling the disposal of human waste. Nearly all stakeholder groups responded positively to local government handling the removal of human waste, although support for local government was not as strong as county, state, or resort handling.

In the short answer response section to this topic, respondents expressed desire for several infrastructure additions, including checkpoints on lake accesses for documenting users, dump stations, defibrillators at resorts, a place to park wheelhouses off the lake (on land) and some way of restricting the number of wheelhouses on the lake. Some notable responses included “More than one dump station open during the winter months,” and

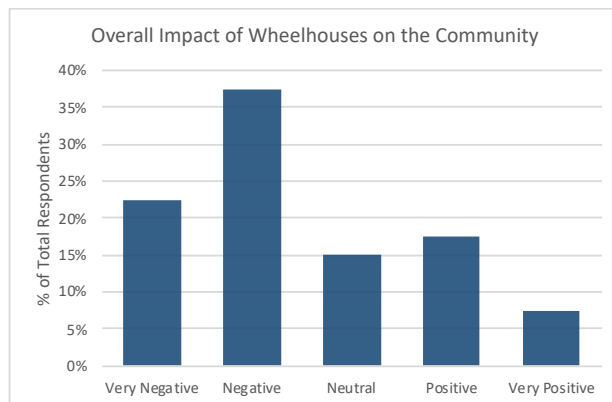
There needs to be a "camping fee" implemented on any and ALL sleeper fish houses/wheel houses that are occupied with overnight guests. Can you go to a MN State Park in the summer and camp for free? (NO) Then why should you be able to do it in the winter, on this lake, or any lake?

## Community Web Survey Round 2

Respondents were first asked two index questions to determine which stakeholder groups they most identify with and to determine their general attitude toward wheelhouses. Compared to the first survey, the second survey had a higher percentage of respondents identify with the resort owner, manager, and employee stakeholder groups.

The second survey also had a higher

Figure 10: Overall impact of wheelhouses (round two).



percentage of respondents who generally felt negatively about the overall impact of wheelhouses

on the community. After answering the two index questions, respondents were asked to provide opinions on topics such as dumpster placement and funding, emergency services, governance on the frozen lake, and various floated policy ideas. The thirteen questions on these topics were based on responses to questions in the previous survey.

### Dumpsters

Opinions on the Keep-It-Clean Committees dumpster program were varied, though most respondents agreed that dumpsters should be placed at access points to the lake for use by anglers. Resort owners and employees expressed support for paying for reinstating dumpsters through a policy requiring wheelhouse owners to purchase licenses to go on the lake. Many government employees and other business owners and employees expressed that multiple funding mechanisms should be combined, including participation from various types of stakeholders, or alternatively that resorts should be responsible for providing dumpsters on their access, rather than the public. In a later response to a different proposal, one respondent noted that theft of service might also be reduced if dumpsters are located on resort property and privately managed, stating

[It would be] much better if each resort would have garbage facilities communicated to customers so they know where to get rid of trash when coming off of the ice. If public dumpsters, everyone will continue to dump garbage...[the] problem would go away if private businesses had dumpsters.

### Emergency Services

Regarding emergency services, the vast majority of respondents agreed that resorts are often called on to provide emergency services for lake users often or occasionally, though respondents were divided as to whether this is sustainable or needs to be changed. The vast majority of resort owners and employees who responded felt that resorts providing emergency services is a problem and needs to be changed.

### Wheelhouses

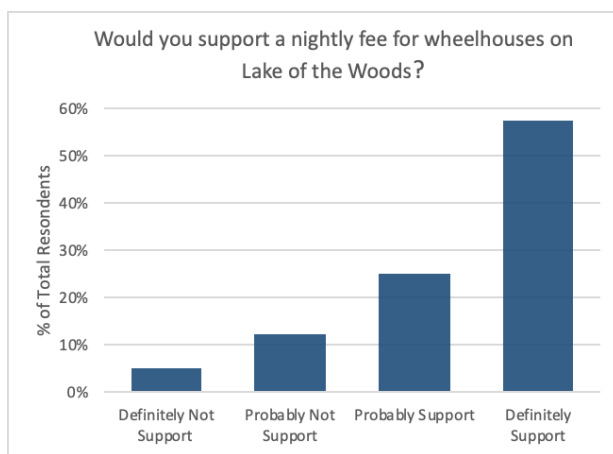
Most respondents agreed that management of wheelhouses on the lake was mostly provided by resorts, and some specifically mentioned Adrian's resort and Zippel Bay resort, though the DNR and tourism bureau were also mentioned. Some respondents felt that no one was successfully managing wheelhouse traffic. When asked who would be responsible for managing wheelhouses in an ideal world, most respondents named the DNR, the county, or the state, and others noted that resorts should maintain oversight over wheelhouses on a day-to-day basis.

In the short answer response section to this topic, notable responses included “I don't feel that there's any management of wheel houses right now,” and “The only ones managing the traffic is each resort who has an ice road. No other rules or managing agencies.” When asked who would manage wheelhouses in an ideal world, one respondent replied with

In an ideal world, it would be nice to have some kind of a permit program potentially limiting the number of houses and the funds go to the Keep It Clean committee to do good things. Another option is to put the responsibility on the resorts operating ice roads as they could actually do a better job of policing.

### Policy Exploration: Lake Access Surcharge and Nightly Fee

Figure 12: Support for nightly fee on Lake of the Woods.

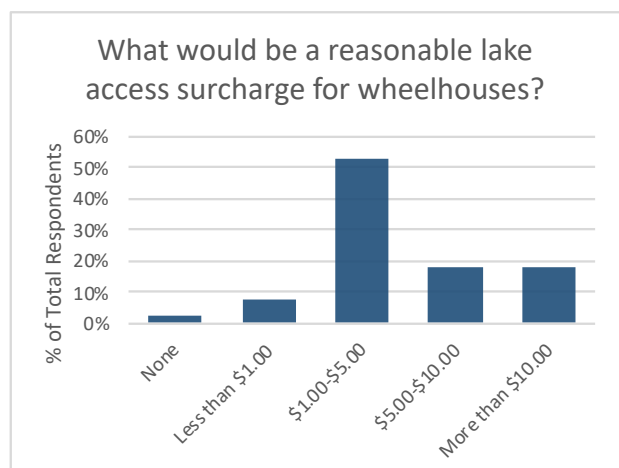


Respondents were asked to comment on a variety of unspecific policy proposals, with the goal of gauging general opinion on different policy directions. The majority of respondents expressed support for a policy that would limit the number of wheelhouses on the ice at a time, with most resort owners and employees expressing support. About 80% of respondents also supported the idea of imposing a nightly fee on wheelhouses, similar

to those imposed on campers using state parks. The vast majority of resort owners and employees supported this policy idea. A small majority of respondents expressed that wind-proof trash receptacles on the ice, or other ways of preventing trash from being blown by wind while out on the ice, would be a worthwhile possibility to pursue if it was deemed to be feasible.

Adding a surcharge onto lake access fees to help pay for services was generally popular in the first survey and remained popular in the second. However, some respondents expressed issues with oversight, believing that anglers might avoid paying, resorts might avoid accurately reporting

Figure 11: Reasonable lake access surcharge (round two).



receipts, or that resorts should be responsible for services, and that money should not have to be raised (and that keeping dumpsters private, specifically, might help reduce theft of service. A small majority of respondents supported a \$1 to \$5 surcharge, and a majority of the remaining respondents support a surcharge over \$5, while very few supported a surcharge below \$1.

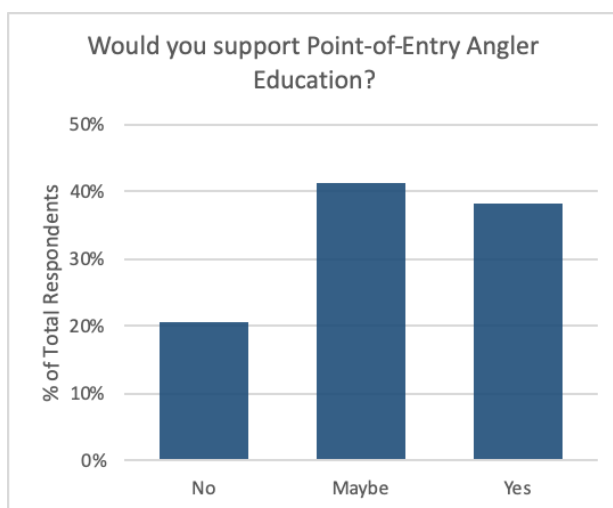
In the short answer response section to this topic, notable responses included “I don't support this policy because I have reason to believe that some resorts do not report cash sales of road pass fees, so any surcharge would not be reported accurately,” and

I would support this policy because wheel houses are going to pay for a road pass no matter what, if there was an additional dollar added to the cost of each road pass that is delegated to the Keep it Clean dumpster program we could raise a significant amount of money.

### Policy Exploration: Required Orientation for Anglers

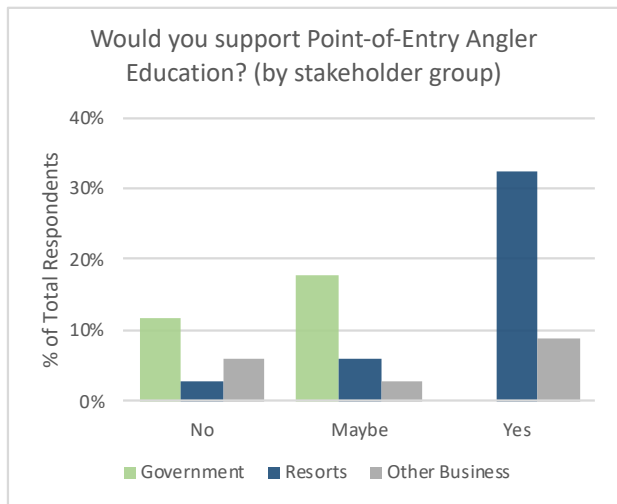
Finally, respondents were asked whether they would support education or orientation about protecting the lake and keeping it clean at access points as a policy solution to misuse of the lake by wheelhouse owners. This policy idea received mixed responses, with nearly half responding “maybe,” just under 40% responding “yes,” and about 20% responding “no”. Most of the “no” responses were skeptical of the ability to enforce this and believed that anglers would not be amenable to participating.

Figure 13: Overall support for angler education program.



Most resort owners and employees supported the idea, and felt it would be useful in spreading information, especially for first-time anglers. On the other hand, no government stakeholders expressed definite support for this approach, with all responses split between “no” and “maybe”. Many of the “maybe” respondents felt that the policy would only be successful if the orientation was very quick and easy, or administered online or as part of the licensing process, as anglers would not want to participate in anything on their way out to the lake.

Figure 14: Support for angler education program by stakeholder identification.



In the short answer response section to this topic, notable responses included “It would have to be quick and easy, I don’t see many people stopping to take a 30 minute class to be able to fish. Maybe if it was part of the licensing process,” and

Not a problem. It would highlight many items that most people did not think about or plan for. Not necessarily because they wouldn’t. Because they were thinking of too many other things like packing gear, food, license, where to go, who was with them. Etc etc. there are many first timers to this.

## Social Media Analysis

Review of the relevant Facebook Group pages revealed several trends. First, discussion within these Facebook groups is by-and-large, focused on fishing reports, weather conditions, and ice-road conditions. There are very few posts and discussions that stray from these topics. In fact, the ‘Lake of the Woods Reel Fishing Reports’ Facebook group states in their rules that questions about resorts, resort recommendations, advertisements, and product questions are not allowed. The ‘Lake of the Woods Fishing’ Facebook group does not have these restrictions. Because of this, most posts regarding trash found on the lake, illegal activity, and questions/problems with resorts was posted to the ‘Lake of the Woods Fishing’ page. On this page, there were several posts that featured photos of trash found on the Lake, as well as posters reminding anglers to bring their trash home with them. These pages also featured numerous posts regarding the ice roads, including discussions of ice road conditions, ice road fees, the resorts charging those fees, and wheelhouse traffic. It is clear that the aforementioned pages also provide



a place for anglers to share their fishing success and local intel, such as where to fish, which entry point to use, what fishing gear to use, and any updates to local or state fishing law.

Facebook pages also provide a space for anglers to ask questions, request or present information, make comments, and put forward criticism and praise, all of which may increase citizen participation and community building. The specific content found on the three aforementioned Facebook groups is not relevant to this report, but the review of these pages has confirmed that these pages are used frequently by Lake of the Woods anglers, resort owners, fishing guides, and LOW residents. These Facebook pages provide a space where information can be shared rapidly between groups of people who may otherwise not come into contact with one another. Although the main goal of these pages is to share fishing reports and ice conditions, they can also be places for anglers to discuss current events and trends that they are observing in LOW. Issues, such as the discovery of debris left on the lake or an overflowing dumpster, can be shared on these pages and dealt with quickly. These three pages have a collective of over 148,000 followers, and receive an average of ten posts a day, allowing both LOW residents, and out of town visitors to share pertinent information with each other

## SWOT Analysis

This SWOT analysis brings together our qualitative research with community stakeholders, our understanding of the current state of ice fishing in the Lake of the Woods region, our findings from the Lake Mille Lacs and Red Lake case studies, and the literature on environmental management approaches.

### Strengths

#### Common Ground

The strengths identified in the SWOT Analysis can be categorized into two distinct groupings. The first grouping is represented by stakeholder involvement in Lake of the Woods region. From the survey data, it is inferred that Lake of the Woods is important to all stakeholders. A majority of the stakeholders also agree that littering is a problem and there are potential solutions to the problem.

#### Stakeholder Engagement

The high levels of engagement throughout the survey process has generated good information and new ideas. Lastly, there is an established stakeholder network working across

government departments in the form of the Keep It Clean Committee. This is a clear step in the direction needed to successfully manage the complexity of the local ice fishing industry.

### Traditional Environmental Management

Environmental management through the SWCD, DNR, and other governmental organizations is extensive and well-documented. Watershed Restoration and Protection Strategies (WRAPS) and Total Maximum Daily Load (TMDL) studies in Lake of the Woods region are currently in progress. Lake of the Woods has a fishery management plan to maintain a sustainable fishery and DNR population data indicates that the walleye fishery is strong. Work related to water quality, wildlife habitats, infrastructure, and the local knowledge base is now being consolidated for the entire watershed in the Lake of the Woods Watershed Comprehensive Management Plan 2019-2028.

### Weaknesses

#### Lack of Coordinated Decision-making

There is a lack of coordinated decision-making and governance structures related to ice fishing and ice fishing infrastructure. A lack of formal governance structures within ice villages, local resorts, and local government makes reliable and equitable funding for infrastructure a challenge. There is also some stakeholder disagreement about where responsibility lies for infrastructure problems and what the role of KIC should look like.

#### Uniqueness of Challenges Facing Lake of the Woods

At nearly 1,679 square miles in size, Lake of the Woods is unique in its scale, high quality fisheries, and remoteness. These factors are what make Lake of the Woods such a special place for both visitors and residents alike. Unfortunately, the unique characteristics of Lake of the Woods also mean that there are few lakes in the region and the country that have comparable management considerations. While Lake Mille Lacs and Upper Red Lake are two large Minnesota lakes with strong ice fishing traditions, they are considerably smaller than Lake of the Woods. Additionally, Lake Mille Lacs proximity to the Twin Cities Metropolitan Area differentiates it from Lake of the Woods. This lack of similar lakes makes it difficult to compare management strategies, policy, and governance structures across lakes. Furthermore, because tourism is a significant part of the local economy, any disruption has potentially major consequences for the local community.

## Threats

### Resource Exploitation

Ice fishing hours and harvests of walleye as well as sauger have increased dramatically starting around the year 2000 as shown in **Figures 3, 4, and 5**. Some comments from the survey stated a fear that the walleye fishery may hit a “tipping point” as a result of this additional pressure. Another threat stems from the uncertainty about other potential drivers of change in the socio-ecological system such as other changes in other fishery systems, climate change, and technology development. Limited data is available to analyze these driving forces but the case study analysis highlights the effect of other systems.

### Socio-economic Impacts of Wheelhouses

The last category of threats is the economic impacts from a changing ice fishing economy. Advances in equipment, wheelhouse popularity, and geographically dispersed spending all have an impact on the local economy. Wheelhouse use allows anglers to avoid lodging fees at resorts and changes the process of purchasing goods for their fishing trips. Wheelhouses provide extra travel space that can store food and other commodities that are purchased outside of the LOW region. Stakeholder data and comments from the surveys suggest that many key stakeholders believe wheelhouses are, in general, having a negative impact on the community. However, there is a sizeable minority who believe that wheelhouse popularity has a positive impact on the region. The polarization of these opinions presents a threat to successful governance of the ice fishing industry as a whole.

### Disruptions to the current governance system

A primary threat identified through our case studies is the disruption of local governance of ice fishing communities through the use of top-down policymaking. According to survey results, there is uncertainty over who holds responsibility for managing independent wheelhouse owners using Lake of the Woods. This uncertainty can diminish trust in state agencies that are developing and enforcing environmental management strategies as well as hinder management of emerging and unforeseen challenges, particularly if policies are enacted without sufficient community input.

## Opportunities

### Build on Common Ground

Focusing on the common ground in the community with regard to the importance of Lake of the Woods provides a starting point from which to address the littering problem and future challenges. The survey results showed commonly held beliefs on several of the survey topics such as a lake access surcharge fees, littering and emergency services. The common ground that is already established can be strengthened by efforts to extend communication and inclusivity during committee decision making process', especially with resort owners.

### Improve Education Initiatives

The first opportunity is the potential to improve existing KIC educational initiatives by focusing on point of contact with anglers and integrating the science of behavior change. Many anglers who own a wheelhouse have limited direct contact with the communities that are within the Lake of the Woods resource. The emotional disconnect between the anglers and the resource is a potential source for the resource abuse. KIC has the opportunity to lessen the angler and resource disconnect by establishing direct contact with anglers and integrating the science of behavior change.

### Start with a Success

Our research suggests that littering on LOW is a widely acknowledged issue with significant stakeholder buy-in for several potential approaches to help mitigate the problem. At the same time, littering does not pose the same threat to the community that a collapse of the recreational fishery would, for example. Therefore, we see an opportunity for community collaboration to address the littering issue that would also build the foundation for addressing more serious threats that the community may face in the future.

## Recommendations

Based on our research and analysis, we have developed a set of recommendations for the Keep It Clean Committee that work with the current governance structures in place, build off of the strengths we have identified, and take advantage of the opportunities for creating positive impacts in the Lake of the Woods community. These recommendations seek to address the short term challenge of managing the littering problem on LOW and the long term challenge of effectively managing this invaluable shared resource in the face of many uncertainties.

### **Work toward developing and implementing a lake access surcharge**

In our surveys, this policy option received broad support across stakeholders groups as well as a relative consensus on an acceptable range of \$1-\$5. This type of approach to funding infrastructure and educational programs has the distinct advantage of increasing the funding available as more people access the lake. Survey respondents also brought up valid concerns about the difficulty of administering this program and ensuring accurate reporting, particularly with cash sales. These concerns must be addressed as part of the development of the policy if it is to be successful at providing additional funding for the work of the Keep It Clean Committee without escalating tensions between key stakeholders, particularly owners of different resorts in the county.

### **Focus educational efforts on point-of-contact interactions**

Wheelhouses lessen the extent to which many visiting anglers interact with the local community, so we recommend focusing educational efforts at the resorts where anglers purchase permits to access the ice roads. This brief window provides the best opportunity to develop a meaningful connection between the actions of anglers on the ice and the health of the lake and surrounding communities. These educational efforts should be co-developed with resort owners and employees, who expressed a substantial level of support for some form of angler orientation program. We suggest the Boundary Waters Permit Videos as one possible template for what this orientation could look like.

### **Expand the role of resort owners and employees in the Keep It Clean Committee**

In order to improve the chances of successfully developing and implementing the above recommendations, we return to one of the key findings of polycentric governance: conservation mechanisms are improved by the incorporation of diverse local perspectives and knowledge. In

order to effectively manage ice fishing on LOW and develop appropriate conservation mechanisms, we see a need for both resort owners and fishing guides to be actively involved in the work of the committee for two reasons: first, resort owners currently provide a wide variety of services in ice fishing communities, some of which are traditionally held by government in other circumstances. Second, our conversation and survey results clearly show the depth of knowledge that resort owners and fishing guides have of the lake and suggest that they may be in the best place to anticipate future challenges.

### **Continue community engagement**

Building on the understanding that public participation brings in valuable perspectives and ideas, we recommend continuing to invite community input around the littering problem and future challenges through surveys, town hall meetings, or other approaches. Our survey process generated significant participation across stakeholder groups and identified a significant amount of common ground in terms of the value of the lake to the community and the problem of littering on the ice. Survey participants also voiced a wide range of ideas and opinions about other concerns and potential solutions.

However, there are also many voices that are largely missing from our surveys. Community members that are less directly involved in ice fishing through resort or government work are significantly under-represented in our survey, as are the anglers that enjoy visiting Lake of the Woods. While these groups have less of a stake and less power than the key stakeholders in this project, their concerns and ideas are nonetheless important and more work must be done to reach them.

### **Continue to collaborate with the University of Minnesota**

We recognize that the challenges facing the communities around Lake of the Woods cannot be fully explored within the limited time frame of a one semester capstone project. Our hope is that this project provides a baseline understanding of the context within which other, more targeted projects could take place. Of the many research directions that we were unable to pursue due to the constraints of our project timeline, we have identified two potential projects that we believe have the greatest potential for positively impacting the work of the Keep It Clean Committee now and in the future:

- Educational program design: We see a great deal of potential in using research on habit formation, social norms, and behavior change to inform the educational materials and programs produced by the Keep It Clean Committee. A project targeting this particular could be particularly helpful in creating an angler orientation program or other point-of-contact educational materials
- Expanded case study research: While the details of the situation in Lake of the Woods are unique, communities around the world are working deliberately to meet the challenges of managing finite shared resources. With the baseline understanding of the local context provided by this report, a future project that explores the extensive literature of local resource management and governance could provide a range of approaches for the Lake of the Woods community to consider. The book “Governing the Coastal Commons: Communities, resilience, and transformation”, edited by Derek Armitage, Anthony Charles, and Fikret Berkes would provide an excellent starting point for this project.

## Barriers to implementation

Given the complexity of the challenges facing the Lake of the Woods Keep It Clean Committee and the community as a whole, there are barriers to the implementation of any of these recommendations. Policy solutions including the lake access surcharge or a nightly fee for wheelhouses may be beyond the jurisdiction of the county and require legislative action at the state level. An angler orientation may be easier to develop locally but ensuring universal adoption at resorts may be difficult. Integrating more resort owners and employees into the work of the Keep It Clean Committee will require care in order to avoid the appearance or occurrence of favoring a particular set of resort viewpoints rather than integrating experiences and knowledge from the full range of approaches to running a successful fishing resort on Lake of the Woods. In order to navigate these challenges, we emphasize the importance of keeping stakeholders engaged and at the table as the Keep It Clean Committee develops its environmental management strategies in order to build trust and strong working relationships within the community.

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## Appendix I: In-Person Interview Questions

### Round 1 Interview Questions

Guiding theme: What we're looking for is some qualitative understanding of how people are feeling about the ice fishing on Lake of the Woods, changes they've seen, and what they think the future looks like, particularly challenges they see coming.

#### **For Ice Anglers:**

1. How many days will you spend out on the lake on this trip?
2. Are you from nearby, or out of town?
3. Are you staying at a resort / hotel or using other lodging?
4. What kind of fish house are you using? Resort house, wheel house, collapsible, none
5. What do you like most about the experience of ice fishing at LOW, or what about LOW in particular draws you? What would improve the ice fishing experience?
6. Are there any services that could be provided to make waste (garbage, septic) disposal easier?
7. Are there any other services (grocery stores, emergency services, plowing, etc.) that are not being provided locally that you would like to see provided?
8. What does preparing for a trip to Lake of the Woods look like for you? What percentage of supplies for your fishing trip do you purchase outside of the area before arriving?
9. How about when you pack up on the ice when you are done ice fishing? Do you normally carry everything out? What do you do with your garbage? Are there any resources you use in town or at the resorts before leaving (dumpsters, gas stations, etc.)?

#### **Stakeholders (this script for business/resort owners; similar line of questions for public officials):**

1. How long have you been living/working in the Lake of the Woods area?
2. Are you from LOW originally or did you move here?
3. Are there any services that you think are needed or you would like added around the lake?
4. (For stakeholders not on Keep It Clean Committee) How have you interacted with the Keep It Clean / AIS committee? (Dumpster program, educational materials, other? What do you see as their role in the recreational community on and around LOW?

5. In the time you have been living/working in Lake of the Woods, have you noticed changes in the way people ice fish? If so, what are these changes? How have you adapted to these changes? From your perspective, are these changes positive or negative to your business?
6. With current ice fishing trends, what risks to the health of the lake or safety of anglers do you see? How should they be addressed?
7. Are there any policy changes (on the part of the local community, other resorts, DNR, etc.) that you would like to see take place to benefit either your business or the ice fishing community as a whole?

**Resort owners only:**

1. What are the amenities/accommodations are offered when a customer rents a day house or sleeper fish house?
2. What services are offered to anglers staying at your resort who rent a fish house?
3. Do you operate or work with another resort who operates an ice road? If yes...
4. Do you offer dumpster service for your customers who pay a road access fee?
5. If yes, what % of anglers fishing with you use your dumpster?
6. If no, what do your customers do with their garbage?
7. Do you believe it is the responsibility of a business collecting revenue for access to the lake to provide dumpsters for their customers?

## **Appendix II: Web Survey Questions**

### **Round One Survey Questions**

To begin, you will be asked four broad questions to determine whether you feel the health of the Lake of the Woods impacts you or your community

Please indicate how much you agree with the following statements:

1. The health of the Lake of the Woods is important to the community in which I live  
Strongly Agree  
Somewhat Agree

Unsure  
Disagree

2. The health of the Lake of the Woods is important to the community in which I work

Strongly Agree  
Somewhat Agree  
Unsure  
Disagree

3. Ice fishing on the Lake of the Woods is an important part of my lifestyle

Strongly Agree  
Somewhat Agree  
Unsure  
Disagree

4. Ice fishing on the Lake of the Woods is important to my work/livelihood

Strongly Agree  
Somewhat Agree  
Unsure  
Disagree

5. How would you describe your relationship to the communities surrounding Lake of the Woods? (Please check all that apply)

Resident  
Elected Official  
City, County, or State Government Employee  
Resort Owner or Manager  
Resort Employee  
Other Business Owner or Manager  
Other Business Employee  
Frequent Visitor (non-resident)

### Other

This survey will consist of twenty questions. None of these questions will be required to complete the survey. Twelve questions are multiple choice or true/false with space for optional explanations. Nine of the questions are open-ended, short-answer questions. Average time to complete the survey is 10 minutes.

### Littering and Trash Cleanup

1. Do you think that littering during the ice fishing season on Lake of the Woods is a problem that needs to be addressed?

Yes

No

2. To what extent does littering on Lake of the Woods affect your recreational or business activities?

Very much

Somewhat

Not at all

3. What do you think are the most effective ways to reduce littering/illegal dumping? (Please Rank - 1 being the most effective, 4 being the least effective)

Establishing stricter penalties for anglers

Marketing/awareness campaigns

Improving waste collection and/or infrastructure

Other (please specify)

4a. Do you think local governments or organizations such as the Lake of the Woods Keep-It-Clean Committee should play a role in reducing littering/illegal dumping on Lake of the Woods?

Yes

Neutral

No

4b. What does this role look like to you, ideally?

5a. Do you think ice fishing resorts should play a role reducing littering/illegal dumping on Lake of the Woods?

Yes

Neutral

No

5b. What does this role look like to you, ideally?

6. The Lake of the Woods Keep-It-Clean Committee maintained dumpsters at lake access points for use by anglers until the 2018-2019 season, at which time dumpsters were removed due to overuse, theft of service, and unsustainable maintenance costs. Do you believe that the Lake of the Woods Keep-It-Clean Committee should reinstate the policy of providing dumpsters on lake access points for use by anglers? Please provide details if applicable.

Yes

Neutral

No

7. One potential policy to offset the cost of reducing littering on the lake would be to add a surcharge to lake access fees. Revenue from this surcharge could go toward waste collection/reduction projects and infrastructure. Would you support such a policy?

Yes

Neutral

No

8. What do you think would be a reasonable surcharge to add to lake access fees, if any?

None

<\$0.25

\$0.25

\$0.50

\$1.00

>\$1.00

#### Wheel Houses

(Portable ice fishing shelters with amenities such as restrooms - generally owned by anglers, not resorts)

9. The use of wheel houses during ice season has increased in the past 10 years, and appears to be continuing to rise. How does this growth affect you and/or your business?

Very Positive

Positive

Neutral/No effect

Negative

Very Negative

10a. What impact do you think wheelhouses have had on the economy as a whole in the Lake of the Woods region?

Little impact

Some impact

Major impact

10b. Short answer follow-up: Are there particular business or sectors of the economy that have been particularly affected and if so, has the impact been positive or negative?

11a. (Business Owners) Has the use of wheel houses caused you to make changes to your business?

Not at all

Some changes

Major changes

N/A

11b. What changes were made to your business, if any?

12a. Are there any goods and services needed by ice fisherman that is not offered by local businesses in the Lake of the Woods region?

Yes

No

Unsure

12b. What goods and/or services are not currently provided that you would like to see provided?

13. Overall, how do you perceive the impact of the increase in wheel houses on communities surrounding the Lake of the Woods?

Very Positive

Positive

Neutral/No effect

Negative

Very Negative

14. "In the past decade, the number of winter visitors who use local infrastructure but do not contribute to the local economy has increased."

Do you agree with the above statement?

Yes

No

Unsure

15. Wheel houses are unique in ice fishing in that anglers themselves, not resorts, are responsible for taking human waste off the ice and disposing of it. In your opinion, do the communities surrounding the Lake of the Woods contain sufficient infrastructure for individual anglers to dispose of human waste?

Yes

No

Unsure



16. If more infrastructure is needed for disposal of human waste, by whom should it be provided? (Check all that apply)

Local Government

County or State Government

Resorts

Other Businesses

Other (please specify)

N/A

17. Have wheel houses contributed to any other changes (positive or negative) in the ice fishing industry or in the local economy that were not considered in this survey? Please specify.

Positive

Negative

Both

Neither

Emergency Services

18a. In your opinion, is the availability of emergency services (fire, police, emergency medical response) adequate on the LotW during ice season?

Yes

No

18b. Which, if any, emergency services on the lake need to be improved?

19. What, if any, infrastructure related to ice fishing or use of wheel houses does not currently exist in the Lake of the Woods or surrounding communities that you would like to see put into place?

20. This is the first of a maximum of three rounds of surveys. Based on your knowledge of the health status of the Lake of the Woods, the impact of ice fishing on the Lake, and the impact of

ice fishing on communities surrounding the lakes, what topics were not brought up in this survey that should be included in following surveys?

## Round Two Survey Questions

This is Round 2 of the Lake of the Woods Community Stakeholder Survey. Please feel free to participate regardless of whether you responded to Round 1 of the survey! These 15 questions were generated based on the responses to the previous survey, and will be used to explore topics or ideas not previously covered, or to look more deeply into topics already addressed.

1) How would you describe your relationship to the communities surrounding Lake of the Woods? (Please check all that apply)

Resident

City, County, or State Government Employee

Resort Owner or Manager

Resort Employee

Other Business Owner or Manager

Other Business Employee

Frequent Visitor (non-resident)

Other (please specify)

2) Overall, how do you perceive the impact of the increase in wheel houses on communities surrounding Lake of the Woods?

Very Positive

Positive

Neutral/No Effect

Negative

Very Negative

3) If it was determined to be feasible, would you support a policy that limits the total number of wheelhouses on Lake of the Woods? A policy like this might require wheelhouses to obtain licenses to access the lake, or use some other method of regulating total wheelhouse numbers.

I would definitely support this

I would probably support this

I would probably not support this

I would definitely not support this

4) It has been suggested that a significant amount of littering on the lake by anglers could be accidental, due to trash being carried by wind. If some way to safely dispose of trash while on the lake, such as wind proof receptacles, were found to be feasible to implement, do you think it would have significant impact on the amount of litter left on the lake during ice season?

Yes, this is worth looking into

This might be worth looking into

No, this is not worth looking into

5) If it was determined that the Keep-It-Clean Committee would be able to reinstate its program of locating dumpsters on lake access points, which of these methods of paying for dumpsters would you support? (check all that apply)

Paid for by resorts

Paid for by requiring wheelhouse users to purchase licenses

Paid for by raising fishing license fees

Paid for by charging anglers a fee to use dumpsters

Paid for by local governments and organizations (previous funding structure)

Other (please specify)

None / I do not support reinstating dumpsters

6) If dumpsters are to be reinstated, where do you think they should they be located?

7) One potential policy to offset the cost of reducing littering on the lake would be to add a surcharge to lake access fees. Revenue from this surcharge could go toward waste collection/reduction projects and infrastructure. This policy was largely supported in responses to the previous survey. If relevant, please provide reasons why you would or would not support this policy, or stipulations ("I would support this policy if..." etc.)

8) Responses to the initial survey indicate that a lake access surcharge of \$1.00 or more is generally supported. Of the following options, what would be a reasonable access surcharge, if any?

None

Less than \$1.00

\$1.00 - \$5.00

\$5.00 - \$10.00

More than \$10.00

9) It was indicated in responses to the previous survey that many anglers and lake users call on resorts as first responders and to provide some emergency services. Would you agree that it is a common occurrence for resorts to provide emergency services?

Yes, often

Yes, occasionally

Yes, but rarely

No, never

Unsure

10) If you believe that resorts are often the providers of emergency services, do you believe this situation is sustainable or functions well?

Resorts rarely/never provide emergency services

Resorts provide emergency services, and it is not a problem

Resorts provide emergency services, and it needs to change

Unsure

11) If it were determined to be feasible to impose a nightly fee for wheelhouses on the lake, similar to fees imposed for using campsites in some state parks, would you support this policy?

I would definitely support this

I would probably support this

I would probably not support this

I would definitely not support this

12) Currently, who would you consider to be most responsible for managing independently-owned wheelhouse traffic on Lake of the Woods?

13) In your ideal world, who would have responsibility for managing independently-owned wheelhouse traffic on Lake of the Woods?

14) A potential program for educating anglers on being safe and keeping the lake clean would be to require independent wheelhouse users to undergo a quick orientation (such as watching a short video, signing a commitment, reading a pamphlet, etc) at the point of entry before going on the lake. Would you support this kind of policy? (You may use space next to answer to provide reasoning)

Yes

Maybe

No

## **Appendix III: Ecological Background Information for Lake of the Woods, Lake Mille Lacs, and Red Lake**

### **Lake of the Woods**

#### **Water Quality**

Water quality in the LOW watershed has been categorized in fair condition overall, with impairment due to E coli. in the West Branch of the Warroad River and high mercury in fish tissues found in both lakes and rivers in the watershed. Lake of the Woods has been declared an impaired water body in Minnesota due to eutrophication that impairs the recreational use of the lake (MPCA, 2016). Following the initial Watershed Monitoring and Assessment Report published by the MPCA, two separate branches of research have been established: the LOW Watershed Restoration and Protection Strategy (WRAPS) Report, which concentrates on the watershed surrounding the LOW, and the LOW Excess Nutrients Total Maximum Daily Load

(TMDL) study, which focuses on the impairment of the LOW due to excess phosphorus concentrations.

## Lake Mille Lacs

### Aquatic Invasive Species (AIS)

Aquatic invasive species in Lake Mille Lacs, specifically spiny water flea and zebra mussels, are believed to be playing a role in the population decline of walleye in Lake Mille Lacs. The presence of spiny water flea and zebra mussel communities can significantly alter the biological food chain in water bodies. Spiny water fleas are microscopic zooplankton that prey on other zooplankton including native varieties. Native zooplankton are an important food source for fish such as walleye. On the other hand, spiny water fleas are not a good food source for fish because their consumption is difficult due to long tails and spines. Similar to spiny water fleas, zebra mussels decrease the availability of food for larval and young fish by preying on small organisms. Spiny water flea and zebra mussel communities remove food from the ecological system placing stress on fish. In addition, spiny water fleas and zebra mussels also increase water clarity which has additional impacts on the walleye population.

### Water Clarity

Lake Mille Lacs water clarity has greatly improved due to regulations of the Clean Water Act and the increasing presence of aquatic invasive species, nearly doubling since the 1980's (MNDNR). Normally an improvement in water clarity would be viewed as an improvement to a water body, but this is not the case for Lake Mille Lacs, at least in terms of the walleye fishery.

In general, walleye are known to feed during low light conditions in higher water clarity lakes because they are not aggressive predators and benefit from the cover limited visibility. In lower water clarity lakes, walleyes will feed during daylight hours because the low visibility of the water combined with limited light makes feeding a challenge. The water clarity of Lake Mille Lacs has allowed sight-feeding fish like bass and northern pike to feed on young walleye. Oppositely, water clarity has made feeding a challenge for the walleye population that depends on the cover of limited water clarity. Aquatic invasive species and improved water clarity have decreased the walleye population by shifting the lower end of the food chain and limiting the opportunity for feeding.

## Water Temperature

Increasing water temperature is another stressor that could be contributing to the walleye population decline in Lake Mille Lacs (Associated Press 2018). Higher water temperatures have indirect and direct effects on the walleye population. Indirectly, higher water temperatures force walleye and their food sources such as cisco to more confined areas of colder water. The confined areas could have increased risk of predation on small walleye. Directly, higher water temperatures can increase hooking mortality of fish (Reeves 2007).

## Red Lake

### Decline in Walleye Fishery

The walleye population decline in Red Lake differs from Lake Mille Lacs because the decline was the result of overharvesting and not changing water conditions. Commercial fishing on Red Lake began during World War I, serving as a source of economic productivity for the region. For many decades, the fishery proved to support a sustainable walleye population until boom and bust cycles of walleye fishing started occurring in the 1970's. The boom and bust cycles as a result of commercial, sport and illegal harvest removed the last strong walleye class prior to reproduction maturity, leading to a collapse in the mid 1990's. Both the state and tribal nation acknowledge the need to establish a cooperative agreement to revive the walleye population and a historical memorandum of agreement was established in 1999. In addition to the closure of the fishery, the state and band conducted three stockings of walleye fry. Early estimates predicted the fishery reopening ten years following the closure, but the revival of the walleye fishery far exceeded expectations and tribal and state waters was reopened to fishing in 2006. Since then, the walleye population continues to thrive and support a sustainable level thanks to the cooperative efforts between the band and Minnesota DNR.